

Contribution to the Flora of north-east Rajasthan¹

BY

L. N. VYAS

Department of Botany, M.B. College, Udaipur, Rajasthan

(With a map)

INTRODUCTION

Rajasthan, one of the largest states of the Indian Union, includes arid and semi-arid areas in the western, north-western, eastern, and north-eastern regions. Information as to the ecological status of the vegetation in different parts of Rajasthan is fragmentary. There is no complete published account of the flora of this region. Therefore, any contribution to the study of the vegetation of this area is of interest and importance.

A striking geological feature of Rajasthan is the presence of the Aravalli Range. This mountain chain divides Rajasthan into two regions, eastern and western. The eastern half is rich in vegetation, the western is unproductive and barren. Eastern Rajasthan is important geographically since it is close to Uttar Pradesh, Delhi and Madhya Pradesh. So, an investigation into its vegetation is bound to reveal some interesting facts as to the phytogeographical and geological status of Rajasthan, an aspect which seems to be unsettled so far (Wadia 1944).

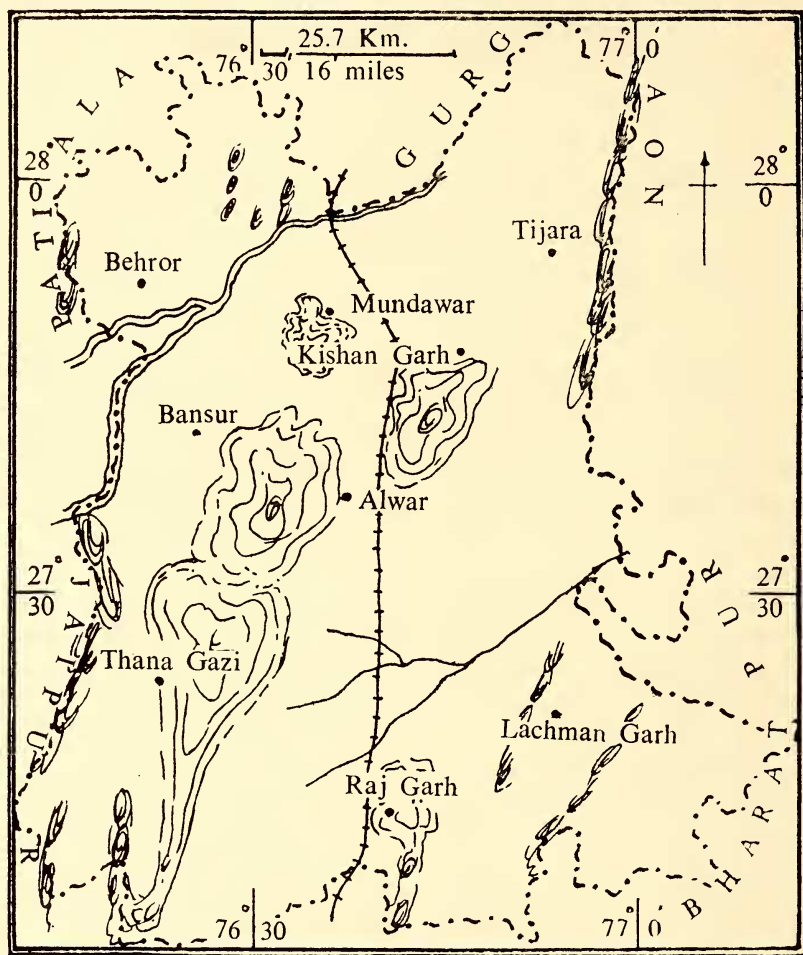
Contributions to the vegetation of north-east Rajasthan have been made by Mulay & Ratnam 1950 ; Ramachandran 1950 ; Ratnam 1951 ; Bakshi 1954 ; Nair 1956 ; Nair & Nathawat 1956, 1957 ; Joshi 1958 ; Sharma 1958 ; Nair & Kanodia 1959 ; Nair 1961 ; Sarup 1961 ; Mulay & Mathur 1961 ; Nair, Kanodia, & Thomas 1961 ; and Vyas 1962. These studies include areas like Pilani, Lohargal, Chirawa, Harshnath, Jaipur, Ajmer, Ajit Sagar, Jhunjhunu, Bharatpur, Tonk, Khetari, and Jai Samand—Alwar.

AREA OF STUDY

For the present ecological survey the area selected is Alwar District, situated in the north-east of Rajasthan between latitudes 27° 5' and 28°

¹ A part of a thesis approved for the Ph.D. degree by the University of Rajasthan.

10' N. and longitudes $76^{\circ} 10'$ and $77^{\circ} 15'$ E. at a height of 283 m. above m.s.l. It is bounded by the districts of Gurgaon in the north,



Maps showing general topography of the area surveyed

Gurgaon and Bharatpur in the east, Jaipur in the south, and Jaipur and Patiala in the west.

The most important topographical feature in Alwar District is the occurrence of long ridges of hills which run as a rule parallel to each other from north or north-east to south or south-west. Their height in some places goes above 760 m. The country is fairly open towards the north-west and south-east with flat plains which lie between 300 and 400 m. above m.s.l. The chief rivers are the Sabi and the Ruparel.

The spots for the present study were selected so as to include a variety of ecological habitats, such as hill-tops and slopes, alluvial and sandy

plains, river beds and water reservoirs and moist banks of such bunds. The places taken into account are Alwar proper, Vijay Sagar, Jai Samand, Pratap Bund, Bhura Sidh, Adapara, Hansarovar, Siliserh, Naldeswar, Kalighati, Pandopol, sandy areas of Behror and Tijara and the rivers Sabi and Ruparel.

CLIMATE

The climate is in general of the semi-arid type. The general average annual rainfall is about 667 mm. distributed over 36 rainy days. An interesting point observed is that the rainfall and the number of rainy days have been slowly increasing. The average annual rainfall for the five years 1956-1960, the period of this study, comes to 830 mm. distributed over 42 rainy days. The mean annual temperature is about 32.6° C. The monthly mean maximum temperature varies between 20.3° C. in January and 44° C. in May. The mean minimum temperature varies from 6° C. in January to 31° C. in June. *Loo* (hot wind) is prevalent during the summer, in the greater part of May and June.

GEOLOGY AND SOILS

The hill ranges in Alwar belong to two great systems, the Aravalli and the Delhi. Both these systems of rocks are of metamorphic nature consisting of mica schists, quartzites, limestones and sandstones.

The physical and chemical characteristics of the soils are the following :

1. Gravel soils occur on the hills ; sand, silt, or sandy loam in the plains ; and loam or clayey loam on the banks of water reservoirs.
2. The gravel and loamy soils are poor in carbonates and chlorides. They are rich in nitrates and have pH ranging from 6.5 to 7.5.
3. The sand and sandy loams are comparatively rich in carbonates and chlorides. These soils are poor in nitrates. The pH value reaches up to 8.5.
4. The humus content in the soil varies from season to season. It is maximum in the winter season. Its value decreases with depth.
5. The water content of the soil is low except in the rainy season.
6. River beds are characterized by soils with poor humus and porosity.

BIOTIC FACTORS

Excessive grazing, local agricultural practices, white ants, and desert locusts constitute the most important biotic factors affecting the vegetation at different phases of its development,

VEGETATIONAL ASPECT

The forests of Alwar fall under the category of deciduous forests of the dry Rajputana region. Without being a desert type, the vegetation is distinctly xerophytic in character. The forest cover is fairly dense during the monsoon months both in the understorey and the growth of the tops of the perennial species. There is an abrupt change in the face of the vegetation as soon as winter sets in, due to low temperature, soil drought, and increased adverse biotic activities. The hot season is the best for the flowering of woody species and the worst month is January. On the other hand, a large number of herbs and shrubs flower in the cold season.

VEGETATION ON THE HILLS

Although the hill-sides are excessively stony and seem bare of soil, they support an extraordinarily rich flora in both herbaceous and perennial species. The typical lithophytic species are arranged in three elevational zones : upper, middle, and lower. The upper zone is characterized by tree species like *Boswellia serrata* (d)¹, *Crataeva nurvala* (c), *Terminalia belerica* (f), *Holoptelea integrifolia* (o), *Mallotus philippensis* (r), and *Euphorbia nerifolia* (c). The middle zone is dominated by *Anogeissus pendula*. This species is associated with *Commiphora mukul* (f), *Lannea coromandelica* (r), *Butea monosperma* (f), *Wrightia tinctoria* (o), *Acacia catechu* (c), etc. In the basal zone are found *Tecomella undulata* (r), *Dichrostachys cinerea* (c), *Acacia arabica* (f), *Gymnosporia spinosa* (c), etc.

The common shrubs and undershrubs of such areas are *Grewia flavescens*, *Rhus mysorensis*, *Securinega leucopyrus*, *Randia tetrasperma*, *Vitex negundo*, *Helicteres isora*, and *Capparis sepiaria*.

The ground cover is fairly dense and does not show much effect of zonation. During the rainy season this type of vegetation includes species of *Tephrosia*, *Abutilon*, *Desmodium*, *Boerhavia*, *Leucas*, *Justicia*, *Sida*, *Ruellia*, *Glossocardia*, *Lindenbergia*, *Chloris*, *Heteropogon*, *Eragrostis*, etc. The herbaceous vegetation during the winter is comparatively poor and is represented by *Blainvillea acmella*, *Vicoa indica*, *Elytraria acaulis*, *Salvia aegyptiaca*, *Blumea napifolia*, *Solanum xanthocarpum*, *Dichanthium annulatum*, *Imperata cylindrica*, *Aristida depressa*, *Cynodon dactylon*, etc.

VEGETATION OF VALLEYS

The perennial species of open and exposed valleys are *Acacia arabica*, *Butea monosperma*, *Balanites aegyptiaca*, *Opuntia dillenii*, *Lycium euro-*

¹ a=abundant ; c=common ; d=dominant ; f=frequent ; o=occasional ; r=rare.

paeum, *Lantana camara*, etc. The cool and shady valleys show a luxuriant growth of *Butea monosperma*, *Mitragyna parvifolia*, *Colebrookea oppositifolia*, *Dendrocalamus strictus*, and *Wrightia tomentosa*.

The characteristic herbaceous species of the shade are *Plumbago zeylanica*, *Ecbolium linneanum*, *Rungia parvifolia*, *Eranthemum nervosum*, and *Elytraria acaulis*.

VEGETATION OF THE SANDY PLAINS

The plains show a vegetation much poorer than that of the hills. The perennial species are *Prosopis spicigera*(a), *Capparis decidua*(a), *Acacia senegal*(c), *Acacia leucophloea*(c), *Acacia arabica*(a), *Salvadora oleoides*(r), *Balanites aegyptiaca*(c), *Zizyphus nummularia*(a), *Calotropis procera*(c), *Clerodendrum phlomidis*(c), and *Gymnosporia spinosa*(c).

The rainy season vegetation is characterized by annuals like *Tephrosia purpurea*, *Boerhavia diffusa*, *Cleome viscosa*, *Cleome gynandra*, *Trianthema triquetra*, *Crotalaria trifoliastrium*, *Farsetia jacquemontii*, *Digera muricata*, *Leucas mollissima*, and grasses like *Setaria glauca*, *Digitaria sanguinalis*, *Tetrapogon tenellus*, *Brachiaria ramosa*, and *Eragrostis pilosa*.

The common climbers and twiners are *Cocculus pendulus*, *Vallaris solanacea*, *Cryptostegia grandiflora*, *Vigna catjang*, *Ipomoea pes-tigridis*, etc.

The ephemeral vegetation generally does not continue beyond November. The disappearance of the rainy season annuals is made good by the winter annuals. The common species of this class are *Argemone mexicana*, *Fumaria indica*, *Fagonia cretica*, *Glinus lotoides*, *Echinops echinatus*, *Chenopodium album*, *Polygonum plebejum*, *Carthamus oxyacantha*, *Heliotropium eichwaldii*, and grasses like *Eragrostis ciliaris*, *Sporobolus tremulus* and *Cymbopogon jwarancusa*.

VEGETATION OF RIVERSIDE AND TANK VICINITIES

Loamy plains are present on the banks of lakes and tanks. Water margins in the rainy season show a luxuriant growth of *Coldenia procumbens*, *Glinus lotoides*, *Eclipta prostrata*, *Borreria hispida*, *Bergia ammannioides*, *Cynodon dactylon*, *Acrachne racemosa*, *Scirpus supinus*, *Eleocharis geniculata*, and *Cyperus distans*.

As the water level recedes the perennials encroach deeper into the lake and wet meadow plants begin to grow. Such species are *Gnaphalium pulvinatum*, *Rumex dentatus*, *Ammannia baccifera*, *Galium asperifolium*, *Fimbristylis squarrosa*, *Cyperus conglomeratus*, *Echinochloa crusgalli*, *Arthraxon lancifolius*, and *Eragrostis coarctata*.

During April and May this type of vegetation is dominated by *Argemone mexicana*, *Xanthium strumarium* and *Echinops echinatus*.

On the slopes of the lakes which are gravelly are found associations of *Saccharum bengalense*, *Sida grewioides*, *Zizyphus xylopyrus*, *Calotropis procera*, and *Adhatoda vasica*.

VEGETATION OF MARSHES

In such areas there are pure stands of *Typha angustata*. On the banks of marshes are commonly found *Bacopa monnieri*, *Ammania baccifera*, *Phyla nodiflora*, *Limnophila heterophylla*, and *Cyperus eleusinoides*. In the puddles grow *Potamogeton nodosus*, *Hygrorrhiza aristata*, *Marsilea minuta*, *Paspalum punctatum*, and *Chara* sp.

HYDROPHYTES

The common floating species are *Nymphoides indicum*, *Ipomoea aquatica*, *Lemna minor*, *Potamogeton perfoliatus*. The submerged species are *Hydrilla verticillata*, *Vallisneria spiralis*, *Utricularia stellaris*, *Ceratophyllum demersum*, and *Potamogeton pectinatus*.

WEEDS OF CULTIVATED FIELDS AND IRRIGATED GARDENS

This group includes *Cleome viscosa*, *Cleome gynandra*, *Physalis minima*, *Striga lutea*, *Digera muricata*, *Hibiscus lobatus*, and *Ipomoea hispida* as the weeds of kharif crop fields; *Fumaria indica*, *Melilotus indica*, *Solanum nigrum*, *Chenopodium album*, *Oligomeris glaucescens*, *Saponaria vaccaria*, *Asphodelus tenuifolius*, *Spergula pentandra*, etc. as the weeds of rabi crop fields; and *Portulaca quadrifida*, *Oxalis repens*, *Anagallis arvensis*, *Verbascum thapsus*, *Withania somnifera*, and *Rungia parviflora* as the weeds of irrigated gardens.

ROADSIDE PLANTS

During the hot months the plants found along the roadsides are mostly hardy perennial shrubs and trees, introduced or indigenous to the area. Such species are *Prosopis juliflora*, *Albizia lebbeck*, *Millingtonia hortensis*, *Melia azedarach*, *Tamarindus indica*, *Moringa pterygosperma*, *Emblica officinalis*, and several species of *Ficus*,

CRYPTOGAMS

The algal vegetation is fairly rich and is represented by a majority of Myxophyceae and Chlorophyceae. A number of parasitic fungi occur on both wild and cultivated plants.

The bryophytic and pteridophytic flora is mostly represented by *Riccia discolor*, *R. gangetica*, *R. plana*, *R. melanospora*, *R. billardieri*, *Cyathodium* sp., *Plagiochasma* sp., *Metzeria raddi*, *Funaria* sp., *Actinopteris dichotoma*, *Adiantum caudatum*, *Dryopteris parasitica*, *Equisetum debile*, and *Marsilea minuta*.

SYSTEMATIC ENUMERATION OF THE SPECIES

The following list of plants collected from the area has been arranged according to Bentham & Hooker's system of classification. Wherever possible, the vernacular name has been given. Every attempt has been made to bring the nomenclature up-to-date with the literature at the author's disposal. The numbers given after the plants refer to collections made by the author. Cultivated species have been marked with a single asterisk while roadside plants bear two asterisks.

ANNONACEAE

Annona squamosa Linn. A small tree. Rare. On hill slopes. Fls. March-May. (664)

***Polyalthia longifolia** Benth. & Hook. f. *Ashok*.

Miliusa tomentosa (Roxb.) J. Sinclair. A very rare tree at Naldeswar. On hill-top. (174)

MENISPERMACEAE

Cocculus hirsutus (Linn.) Diels. *Vajar Bel*. A climbing shrub. Common in valleys and lower parts of hills. Fls. Feb.-March. (170, 215)

C. cebatha DC. *Peelwar*. A common climber. Fls. Nov.-Dec. (665)

C. pendulus (Forst.) Diels. A common climber. Fls. April-May. (28, 307)

Tinospora cordifolia Miers. *Neem Gilol*. A climbing shrub. Rare; in valleys. Fls. April-May. (666)

Cissampelos pareira Linn. A tomentose climbing herb of open valleys. Rare. Fls. July-Oct. (516)

N Y M P H A E A C E A E

- Nymphaea stellata** Willd. A floating aquatic. Common. Fls. white; Aug.-Oct. (667)
- Nelumbo nucifera** Gaertn. Floating aquatic. Fls. rosy red. (668)
- Euryale ferox** Salisb. *Talmakhana*. A densely prickly aquatic. Fls. July-Aug. (651)

P A P A V E R A C E A E

- Argemone mexicana** Linn. A robust prickly herb. Very common. Fls. Jan.-May and Sept.-Oct. (232, 306)

F U M A R I A C E A E

- Fumaria indica** Pugsley A common weed of wheat fields. Fls. winter season. (485)

C R U C I F E R A E

- Farsetia jacquemontii** Hook. *Kag pilong*. Common herb of sandy plains. Winter season. (328)
- Sisymbrium irio** Linn. Common herb of moist places. Winter season. (669)
- Lepidium sativum** Linn. A glabrous herb. Rare. On walls. (670)
- Coronopus didymus** (Linn.) Sm. Annual of most places. Fls. Dec.-Feb. (671)

C A P P A R I D A C E A E

- Cleome viscosa** Linn. Annual; Fl. yellow; July-Nov. in waste places. (45, 243A)
- C. brachycarpa** DC. *Narli*. Herb; rare; on hills. Fls. Nov.-May. (672)
- C. papillosa** Steud. Herb; rare; at foot of hills. Fls. Aug.-Oct. (673)
- C. gynandra** Linn. *Bagra*. A strong smelling herb. Common in sandy areas. Fls. July-Aug. (674)
- Crataeva nurvala** Buch.-Ham. *Barna*. Small tree; on hills, Fls. March-May. (5, 163)

- Capparis spinosa** Lamk. *Kabar*. A shrub of gravelly situations. Rare. Fls. May-July. (147, 149)
- C. zeylanica** Linn. non Hook. f. & Thom. A climbing shrub of valleys. Common. Fls. April-May. (675)
- C. decidua** (Forsk.) Pax. *Ker*. Much branched shrub. Common in plains. Fls. March-April. (676)
- C. sepiaria** Linn. Climbing shrub. Common in rocky areas. Fls. Feb.-April. (73, 115, 405)
- Maerua arenaria** Hook. f. & Thom. A perennial woody climber with leathery leaves. Rare. Fls. greenish-white ; Feb.-April. (492)
- Cadaba farinosa** Forsk. Unarmed straggling shrub of waste lands. Rare. Fls. Jan.-March. (677)

R E S E D A C E A E

- Oligomeris glaucescens** Camb. Annual. Common in fields and moist banks. Fls. greenish-white ; Feb.-April. (652)

F L A C O U R T I A C E A E

- Flacourtia indica** (Burm. f.) Merr. A common tree of hills. Fls. March-April. (454)

P O L Y G A L A C E A E

- Polygala erioptera** DC. Annual. Common on sandy soils. Fls. Dec.-March. (481)
- P. abyssinica** Fresen. A common herb of plains. Fls. Oct.-Dec. (177, 184)

C A R Y O P H Y L L A C E A E

- Polycarpha corymbosa** Lamk. Silvery paniced herb. Common. Fls. Aug.-Nov. (21)
- Spergula arvensis** Linn. Annual with linear subulate leaves in whorls. Fls. white ; Jan.-March. (678)
- S. pentandra** Linn. Annual with fleshy leaves. Common in fields. Fls. Jan.-March. (477)
- Gypsophila alagines** Biell. A herb of winter season. Common on moist banks. (104, 350)

Polycarpon prostratum (Forsk.) Asch. & Sch. Annual; on moist banks. Common. Fls. Jan.-March. (367)

Saponaria vaccaria Linn. A tall robust herb. Fls. white; Jan.-March in fields. (510)

Arenaria serpyllifolia Linn. Decumbent herb. Fls. white; Nov.-Jan. (576)

PORTULACACEAE

Portulaca oleracea Linn. Fleshy annual. Common in moist situations. Fls. Sept.-Dec. (679)

P. quadrifida Linn. Prostrate herb with long stipular hairs. Fls. Nov.-Jan. (680)

TAMARICACEAE

Tamarix aphylla (Linn.) Karst. A shrub or small tree of plains and river-side. Rare. Fls. pink. (681)

ELATINACEAE

Bergia ammannioides Heyne ex Roth. A common herb of moist banks. Fls. Oct.-Dec. (682)

MALVACEAE

Sida acuta Burm. f. Undershrub. Common on roadsides and waste places. Fls. yellow; Nov.-Jan. (500)

S. rhombifolia Linn. Erect undershrub. Common. Fls. Aug.-Dec. (556)

S. grewioides Guill. & Perr. *Kharenti*. An erect grey tomentose undershrub. Abundant in plains and bank of lakes. Fls. yellow; Oct.-Feb. (220, 507)

S. cordifolia Linn. A hairy undershrub. Common on roadsides. Fls. Aug.-Sept. (205, 461)

Abutilon indicum G. Don. A shrubby perennial up to 1.6 m. height. Common. Fls. March-Sept. (1, 195)

A. polyandrum Wt. & Arn. Pubescent annual of hill slopes. Fls. Nov.-Jan. (75)

Pavonia zeylanica Cav. A tall herb. Common at foot of hills. Fls. pink. (358, 359, 475)

Malvastrum coromandelianum (Linn.) Garcke. Erect herb. Common in cultivated and moist places. (60, 123, 555)

Kydia calycina Roxb. *Barong*. A moderate-sized tree of valleys and hill slopes. Fls. Sept.-Nov. (683)

Hibiscus lobatus (Murr.) O. Ktze. Erect annual of cultivated fields. Rare. Fls. Sept.-Nov. (559)

H. ficulneus Linn. A prickly herb. Common in cultivated fields. Fls. Sept.-Nov. (558)

BOMBACACEAE

Salmalia malabarica Sch. & Endl. A large tree. Common on lower zones of hills. Fls. Jan.-April. (292)

STERCULIACEAE

Melhania hamiltoniana Wall. A shrub of hill-top. Rare. Fls. Jan.-March. (362, 363)

M. tomentosa Stocks. A cano-tomentose branched shrub. Rare. Fls. Nov.-Dec. (16)

Sterculia urens Roxb. A moderate-sized tree of hills. Rare. Fls. Dec.-Feb. (684)

Helicteres isora Linn. Shrub of hills and valleys. Rare. Fls. Aug.-Oct. (569)

TILIACEAE

***Grewia oppositifolia** Roxb.

G. tenax (Forsk.) Fiori. *Gangera*. An erect shrub. Common. Fls. Aug.-Nov. (52, 178, 283)

***G. asiatica** Linn. *Phalsa*.

G. columnaris Sm. Much branched shrub. Rare on hill slopes. Fls. April-June. (112)

G. elastica Royle. *Dhaman*. Tree of valleys and hill-tops. Common. Fls. April-May. (685)

G. flavescens Juss. *Chaprend*. A common straggling shrub at hill base. Fls. July-Oct. (174)

Corchorus tridens Linn. Herb of rainy season. Common in plains. (43)

C. trilocularis Linn. *Kagle ki tambakoo*. Annual of waste grounds. Abundant. Fls. rainy season. (77, 78)

C. depressus (Linn.) Stocks. *Chamgas*. Woody herb of rainy season. Rare. (310)

Triumfetta cana Blume. Annual of rainy season, frequent in plains, (364)

T. bartramia Linn. Annual. Fls. yellow; Aug.-Sept. (364A)

ZYGOPHYLLACEAE

Fagonia cretica Linn. A spiny herb or undershrub of winter season. Common on gravel. (288, 289)

Tribulus terrestris Linn. *Gokharu*. Annual prostrate hairy herb. Common in stabilized soils. Fls. yellow; July-Sept. (193)

GERANIACEAE

Oxalis repens Thunb. Perennial herb of moist places. Fls. Oct.-May. (10)

***Averrhoa carambola** Linn.

RUTACEAE

Feronia limonia (Linn.) Swingle. Deciduous thorny tree. Rare on hills. Fls. Feb.-April. (686)

***Citrus aurantium** Linn. ***C. medica** var. **acida** Roxb. ***C. medica** var. **limetta** DC. ***Aegle marmelos** Correa. ***Murraya paniculata** (Linn.) Jack.

SIMAROUBACEAE

Balanites aegyptiaca (Linn.) Delile. *Hingot*. A small grey-green tree or small bush. Common on gravel and rare on hill-tops. Fls. Oct.-Dec. (403)

****Ailanthus excelsa** Roxb.

BURSERACEAE

Commiphora mukul (Hook. ex Stocks.) Engl. *Gugal*. Shrub or dwarf tree. Common. Fls. Oct.-Dec. (688)

Boswellia serrata Roxb. Deciduous tree. Dominant on upper zone of hills. Fls. Feb.-April. (689)

MELIACEAE

****Melia azedarach** Linn.

****Azadirachta indica** Juss.

Cedrela toona Roxb. Deciduous tree of high elevations. Fls. March-April. (690)

CELASTRACEAE

Gymnosporia spinosa (Forsk.) Fiori. Evergreen shrub or small tree. Common. Fls. Oct.-Feb. (284, 378, 521)

RHAMNACEAE

Zizyphus nummularia Wt. & Arn. Bushy shrub. Common. Fls. March-June. (688 A)

Z. xylopyra Willd. Straggling shrub. Abundant at the foot of hills. Fls. April-May. (692)

***Z. mauritiana** Lamk.

VITACEAE

Cayratia carnosia Gagnep. Herbaceous climber frequent in valleys. Fls. July-Sept. (489)

SAPINDACEAE

Cardiospermum halicacabum Linn. Herbaceous wiry climber. Frequent at foot of hills. (179, 213, 357)

Dodonaea viscosa Linn. Common hedge plant. Also as an escape in rocky areas. Fls. Oct.-Dec. (694)

Sapindus emarginata Vahl. Deciduous tree. Rare; on hills. Fls. Nov.-Jan. (540)

ANACARDIACEAE

Rhus mysorensis Heyne. *Dansaria*. Spiny shrub. Common in basal zone of hills. Fls. rainy season. (383, 482)

Lanea coromandelica (Houtt.) Merrill. Large tree. Rare; on hill slopes. Fls. March-May. (410)

***Mangifera indica** Linn.

MORINGACEAE

****Moringa oleifera** Lamk. *Saijana*.

LEGUMINOSAE

Crotalaria burhia Ham. Undershrub. Common in plains. Fls. winter season. (696)

***C. juncea** Linn. Cultivated. Also found as an escape.

C. procumbens Roxb. A diffuse perennial herb of rainy season. (788)

C. trifoliatum Willd. Erect herb. Common in plains. Fls. rainy season. (212)

***Trigonella foenum-graceum** Linn.

T. occulta Delile. Annual of fields. Fls. Feb.-March. (463 & 654)

Melilotus alba Lamk. A herb of cultivated land. Fls. Jan.-March. (476)

M. indica All. A common weed of winter season in fields. (65)

Medicago denticulata Willd. Annual of winter season. Pods with spiny margin. (114, 119, 526)

Indigofera linnaei Ali. *Bhuiguli*. A much branched spreading annual. Fls. Aug.-Nov. Common in plains and grass lands. (138)

I. cordifolia Heyne. *Bechka*. Annual of loose soils and rock crevices. Fls. Sept.-Nov. (44, 57)

I. linifolia Retz. *Pandarphalli*. A prostrate herb. Common in moist places. Fls. Aug.-Oct. (346)

I. astragalina DC. Annual of rainy season. Common in plains. (785)

I. argentea (non Linn.) Burm. A low diffusely branched undershrub with yellowish flowers. Common in plains. (285)

***I. tinctoria** Linn. *Neel*. Also found as an escape. Fls. Sept.-Oct. (139)

I. trita Linn. f. Erect undershrub. Fls. Feb.-March. (655)

- Tephrosia purpurea** Pers. Sub-erect herb with several varieties. Abundant. Fls. Sept.-Jan. (12)
- T. pauciflora** Grah. Annual of plains. Rare. (230)
- T. candida** DC. A frequent annual of hills. (698)
- T. strigosa** (Dalz.) Santapau & Maheshwari. A slender caespitose herb with filiform stem. Fls. pink; Aug.-Oct. (786)
- Sesbania sesban** var. **picta** Santapau. Perennial soft-wooded shrub. Common in wastelands. Fls. Oct.-Dec. (169, 242, 259, 544)
- Alhagi camelorum** Fisch. *Javasa*. Erect thorny annual. Abundant at Hansarovar. Fls. April-June. (140, 141)
- Alysicarpus monilifer** DC. A slender, tufted, prostrate herb. Common in dry places. Fls. Sept.-Oct. (92)
- Desmodium gangeticum** DC. Undershrub. Common on hill slopes. Fls. May-July. (20, 269, 387)
- D. triflorum** DC. Trailing herb of plains. A good sand binder. Common. Fls. Sept.-Oct. (464)
- Vicia sativa** Linn. A sub-erect annual with angular stem. Fls. winter season. (699)
- Abrus precatorius** Linn. *Chirmi*. A woody twiner. Common. Fls. Aug.-Sept. (161)
- Lathyrus aphaca** Linn. A herbaceous climber of winter season. Rare. (67)
- Mucuna prurita** Hook. *Kauch*. Climber. Common in rocky areas. Fls. winter season. (700)
- Erythrina variegata** var. **orientalis** (Linn.) Merr. A tall prickly tree of hills. Fls. March-April. (287 & 653)
- Butea monosperma** (Lamk.) Taub. Deciduous tree. Abundant in valleys. Fls. March-April. (701)
- *Phaseolus mungo** var. **radiatus** Linn.
- P. aconitifolius** Jacq.
- Vigna cylindrica** (Linn.) Skeels. A common twiner of plains. Fls. rainy season. (47)

Rhynchosia minima DC. A common twiner of open jungles. Fls. Aug.-Oct. (381, 414)

****Dalbergia sissoo** Roxb.

****D. paniculata** Wall.

Pongamia pinnata (Linn.) Pierre. *Karanj*. Small tree along river bed. Largely planted. Fls. March-April. (451)

***Pisum sativum** Linn.

***Cicer arietinum** Linn.

Cassia occidentalis Linn. Diffuse undershrub. Common in barren places and hill-tops. Fls. Jan.-March. (26, 256, 331)

C. tora Linn. *Takla*. Gregarious annual. Pod subtetragonous. Fls. Sept.-Oct. (172, 374)

***C. siamea** Lamk.

C. fistula Linn. A medium-sized tree on hill slopes. Fls. April-June. (99, 153)

C. auriculata Linn. *Aval*. A shrub. Common on roadsides. Occasional on hills. Fls. Jan.-July. (202)

Parkinsonia aculeata Linn. Introduced.

****Delonix regia** (Boj.) Raf.

***Tamarindus indica** Linn.

****Bauhinia variegata** Linn. *Kachnar*.

B. racemosa Lamk. *Zinza*. A small deciduous tree of hills and slopes. Fls. March-April. (702)

B. malabarica Roxb. *Apta*. A low bushy tree of hills. Fls. Aug.-Oct. (703)

Prosopis spicigera Linn. *Shemi*. A prickly tree of plains. Fls. Dec.-March. (275)

P. juliflora DC. A small evergreen tree, almost naturalized. (251, 268)

Dichrostachys cinerea (Linn.) Wt. & Arn. A tree common in lower parts of hills and slopes. The spikes red and yellow. Fls. most of the year. (247, 277, 300)

- Mimosa hamata** Willd. A prickly shrub. Common in low jungles. Fls. rainy season. (458)
- Acacia catechu** Willd. Small deciduous tree. Common on hill slopes. Fls. May-July. (704)
- A. jacquemontii** Benth. *Boli*. Deciduous tree of dry sandy soils. Fls. Feb.-May. (705)
- A. arabica** Willd. Common spiny tree. Fls. Aug.-Dec. (259, 348)
- A. ferruginea** DC. *Safed khair*. Middle-sized tree. Rare; on hills. Fls. March-April. (656)
- A. senegal** Willd. *Kumat*. Small tree. Spines hooked in three. Abundant; on hills. Fls. Aug.-Nov. (276)
- A. leucophloea** Willd. *Jhira*. Tree with long spines and terminal inflorescence. Abundant in valleys. Common on hill slopes and plains. Fls. Aug.-Nov. (415)
- **Albizia lebbeck** Benth. *Siras*.
- A. odoratissima** Benth. *Kala siras*. Tree without prickles and with violet pods. Occasional on the hill slopes. Fls. April-June. (271)
- Pithecellobium dulce** (Roxb.) Benth. Small tree with short straight stipular thorns. Pods curiously twisted. Fls. Feb.-March. (537)

R O S A C E A E

- Potentilla supina** Linn. Prostrate herb. Common near water. Fls. Feb.-April. (167, 493)
- P. desertorum** Bunge. Erect herb. All parts covered with soft spreading hairs. Fls. Sunk amongst the uppermost leaves. (706)
- *Rosa indica** Linn.
- *Prunus communis** Linn.

C O M B R E T A C E A E

- Anogeissus pendula** Edgew. *Dhauk*. A dominant tree of middle zone. Fls. Aug.-Oct. (707)
- A. latifolia** Wall. *Dhawara*. Tree frequent on hill slopes. Fls. May-June. (187)
- A. sericea** Brandis. Tree with silky pubescence. Fls. in globose heads. (708)

Terminalia belerica Roxb. Small deciduous tree of hills. Rare. Fls. April-June. (710)

T. arjuna Bedd. Tree. Rare. On hill-top. Fls. April-May. (709)

MYRTACEAE

***Psidium guajava** Linn.

***Syzygium cumini** (Linn.) Skeels.

***Eucalyptus** sp.

LYTHRACEAE

Ammania baccifera Linn. A decumbent winter herb of wet ground. Fls. red. (7, 261)

A. multiflora Roxb. Annual. Fls. in compound peduncled cymes ; Sept.-Nov. (787)

***Punica granatum** Linn.

***Lagerstroemia flosreginae** Retz.

***Lawsonia inermis** Linn.

Woodfordia fruticosa (Linn.) Kurz. *Chaprend.* An evergreen shrub of hills. Fls. brilliant red ; Feb.-April., frequent. (414)

TRAPACEAE

Trapa bispinosa Roxb. *Singhara.* A floating herb. Cultivated as well as wild. Fls. Sept.-Oct. (711)

CARICACEAE

***Carica papaya** Linn.

CUCURBITACEAE

Cucumis sativus Linn. A hispidly hairy climber of plains and hills. Fls. rainy season. (267)

C. trigonus Roxb. A procumbent trailing perennial. Fls. May. (578, 579)

Citrullus colocynthis Schrad. *Indrayan.* Scabrous herb of winter season. Common in plains. (712)

Momordica balsamina Linn. A common climber. Fls. Aug.-Jan. (389)

M. dioica Roxb. Climbing herb. Fls. yellow ; Sept.-Dec. (301, 486)

Melothria maderaspatena (Linn.) Cogn. Annual herb. Common on upper zone of hills. Fls. July-Sept. (304)

***Lagenaria** sp.

Cephalandra indica Naud. Climbing herb of rainy and winter season. Common. (342, 343)

Trichosanthes cucumerina Linn. *Jangli padvel*. Succulent climber. Common. Fls. white ; Aug.-Nov. (582, 583)

CACTACEAE

Opuntia dillenii Haw. A common shrub on gravel. Fls. Feb.-April. (713)

MOLLUGINACEAE

Trianthema portulacastrum Linn. Procumbent, succulent herb. Fls. red ; July-Sept. Common. (714)

T. decandra Linn. Annual, carpels two. Fls. white ; Dec.-Jan. (111)

T. triquetra Willd. ex Rottl. A diffuse much branched, common weed. Fls. Oct.-Nov. (266)

Glinus oppositifolius (Linn.) A. DC. Glabrous herb. Fls. greenish ; Sept.-Oct. Very common. (66)

G. lotoides Linn. A stellate woolly herb of winter season. Abundant in plains and on banks of lakes. Fls. Feb.-April. (715)

Gisekia pharnaceoides Linn. Diffuse, succulent and glabrous herb of dry sandy places. Fls. April-Sept. (483)

UMBELLIFERAE

Psamogeton biternatum Edgew. Annual with umbels of silver pink flowers. Fls. Feb.-March. Rare. (716)

***Foeniculum vulgare** Mill. ***Coriandrum sativum** Linn. ***Trachyspermum ammi** (Linn.) Sprague. ***Cuminum cyminum** Linn. ***Daucus carota** Linn.

ALANGIACEAE

Alangium salvifolium (Linn. f.) Wang. Thorny tree. Prefers well-drained sides of nullahs, Common. Fls. Feb.-April. (576)

RUBIACEAE

Borreria hispida (Linn.) Schum. A hispid erect herb. Abundant near water. Fls. July-Oct. (185, 231, 474)

B. stricta (Linn. f.) Schum. Annual erect herb. Common near water. Fls. Oct.-Nov. (11)

Randia tetrasperma Benth. & Hook. f. Deciduous shrub of hills. Common. Fls. April-June. (657)

Morinda tinctoria var. **tomentosa** Hook. f. A middle-sized tree. Common on hill slopes. Fls. white ; Oct.-Jan. (717)

***Anthocephalus cadamba** Miq.

Mitragyna parvifolia (Roxb.) Korth. Tree common in lower and middle zone of hills. Fls. May-June. (406)

Oldenlandia umbellata Linn. A diffuse annual near water. Fls. Sept.-Dec. (545)

O. corymbosa Linn. Annual herb with white flowers. Aug.-Oct. (567A)

Galium asperifolium Wall. A pubescent herb near water. Fls. March-April. (560)

Adina cordifolia Hook. f. Small tree frequent in open dry jungles. (729A)

COMPOSITAE

Echinops echinatus Roxb. A much branched spreading rigid annual of winter season. Common on banks of bunds and in plains. Fls. April-June. (4, 243)

Eclipta prostrata Linn. Strigose slender herb. Abundant near water. Fls. white ; throughout the year. (186, 360)

Gnaphalium indicum Linn. Slender woolly herb with small flower heads in spikes. Common on dried up banks. Fls. Feb.-April. (63, 109)

G. pulvinatum Delile. Woolly herb on damp ground. Fls. winter season. (56)

- Launaea nudicaulis** Hook. f. Glabrous perennial with yellow flowers in winter season. (311, 536)
- Tridax procumbens** Linn. Straggling herb. Common. Fls. all the year round. (207)
- Vicoa indica** (Willd.) DC. Viscidly pubescent herb with orange yellow flowers ; Nov.-May. (508)
- V. vestita** Benth. Softly hairy herb with bright yellow heads. (191)
- Vernonia cinerea** Less. Erect herb of waste grounds. Fls. most of the year. (48, 297, 534)
- V. cinerascens** Sch. A pubescent shrub of waste grounds. Fls. Sept.-Nov. (565)
- Xanthium strumarium** Linn. Coarse shrub of waste grounds and river banks. Fls. Sept.-Oct. and Jan.-Feb. (24, 82, 204)
- Artemisia scoparia** Waldst. & Kitt. Erect tomentose herb. Frequent. Fls. yellow ; Sept.-Dec. (87)
- Blainvillea acmella** (Linn. f.) Philipson. Erect coarse herb. Common. Fls. Sept.-Jan. (371, 385)
- Sonchus arvensis** Linn. Tall perennial. Common on hills. Fls. Dec.-Jan. (718)
- Blumea laciniata** DC. Coarse aromatic erect herb. Common in open places. Fls. Jan.-Feb. (455)
- B. amplexans** DC. Annual of waste ground and river banks. Fls. yellow ; March-April. (564)
- Glossocardia bosvallea** (Linn. f.) DC. Erect annual. Common on rocks. Fls. Aug.-Oct. (535)
- Carthamus oxyacantha** Bieb. Spinose herb of winter season. Common in plains. Fls. yellow ; March-April. (553)
- Grangea maderaspatana** Poir. Procumbent weed of fields and wet grounds. Fls. Dec.-April. (562)
- Anaphalis adnata** DC. A stout herb with white woolly covering. (563)
- Inula grandiflora** Willd. A perennial. Rare. Fls. Nov.-Jan. (566)
- Wedelia urticaefolia** DC. A weak erect herb of wet places. Fls. Aug.-Sept. (719)

Bidens biternata (Lour.) Merr. & Sherff. Glabrous pilose tall herb. Fls. yellow ; Sept.-Dec. Common in damp places. (569)

Pulicaria crispa Schultz. Stout, shrubby perennial of waste places. Fls. Feb.-May. (720)

PLUMBAGINACEAE

Vogelia indica Gibs. An erect shrub. Rare. On rocks. Fls. Jan.-March. (551)

Plumbago zeylanica Linn. Subscandent perennial herb of shady places. Fls. July-Oct. (491, 504)

PRIMULACEAE

Anagallis arvensis Linn. Annual herb of plains. Fls. blue ; Feb.-March. (102, 103)

SAPOTACEAE

Achras sapota Linn. Tree, planted on hill-tops. Rare. Fls. April. (270)

Manilkara hexandra (Roxb.) Dub. *Khirni*. Small tree on hills. Rare. Fls. Nov.-Jan. (29)

***Mimusops elengi** Linn.

Madhuca indica Gmel. *Mahuwa*. Deciduous tree. Common in valleys. Fls. March-April. (721)

EBENACEAE

Diospyros melanoxylon Roxb. Small tree. Occasional on hill slopes. Fls. May. (658)

OLEACEAE

***Nyctanthes arbor-tristis** Linn. *Sihali*.

***Jasminum multiflorum** (Burm. f.) Andr.

SALVADORACEAE

Salvadora persica Linn. Small tree of plains. Frequent. Fls. Nov.-May. (336, 518)

- S. oleoides** Decne. Large shrub. Common in plains. Rare on hills.
Fls. March-April. (71)

APOCYNACEAE

- ***Lochnera rosea** (Linn.) Reichb.

- L. pusilla** (Murr.) Schum. Erect annual with white flowers. Rare.
Fls. rainy season. (723)

- Wrightia tinctoria** R. Br. Small deciduous tree. Common on hills.
Fls. July-Sept. (79, 498)

- W. tomentosa** Roem. Tree frequent in valleys and damp places. Fls.
May-June. (305, 325)

- ***Nerium indicum** Mill.

- ***Tabernaemontana coronaria** Br.

- Vallaris solanacea** (Rth.) O. Kuntze. *Rubar* A tall evergreen twining
shrub of plains and valleys. Rare. Fls. Jan.-June. (550)

- ***Thevetia peruviana** (Pers.) K. Schum.

- Holarrhena antidysenterica** Wall. A shrub common in lower parts of
hills. Fls. May-June. (724)

- Plumeria rubra** Linn. Cultivated. A small tree with crooked trunk and
rough bark. Fls. Feb.-April. (494)

- Ichnocarpus frutescens** R. Br. Large rambling shrub. Common in
moist places. Fls. Dec.-Feb. (502)

- ***Carissa congesta** Wight.

ASCLEPIADACEAE

- Calotropis procera** R. Br. Large shrub. Common in plains and open
and waste ground. Rare on the base of hills. Fls. most of the year.
(175)

- Pergularia daemia** (Forsk.) Chiov. Climber, common in plains and
rare at the foot of hills. Fls. Oct.-Feb. (235, 347)

- Leptadenia pyrotechnica** (Forsk.) Decne. *Kheep*. Erect nearly leafless
glabrous shrub of sandy plains. Rare. Fls. Oct.-Jan. (166)

- Cryptostegia grandiflora** R. Br. Woody climber. Common in plains. Fls. April-Sept. (725)
- Cryptolepis buehanani** R. & Schult. Twining shrub. Fls. pale greenish-yellow ; April-May. (513)
- Sarcostemma acidum** (Roxb.) Voigt. Leafless jointed shrub on arid rocks. Rare. Fls. Sept.-Jan. (245A)
- Oxystelma esculentum** (Linn. f) R. Br. A slender climbing perennial near water at Tijara. Fls. Sept.-Nov. (788)

GENTIANACEAE

- Nymphoides indicum** (Linn.) O. Kuntze. Floating aquatic. Common. Fls. March-Oct. (511)
- Enicostemma verticillatum** (Linn.) Engl. Perennial glabrous herb. Common near water. Fls. Aug.-Nov. (62, 453)

BORAGINACEAE

- Coldenia procumbens** Linn. Annual hairy herb. Common near water. Fls. Aug.-Oct. (547)
- Heliotropium supinum** Linn. A villous annual. Common on hill slopes and banks of bunds. Fls. Feb.-March. (38, 128, 129)
- H. strigosum** Willd. Procumbent herb of dry pastures. Fls. all the year round. (459)
- H. marifolium** Retz. Decumbent herb. Fruits densely strigose. Fls. Oct.-Jan. (116, 152)
- H. eichwaldii** Steud. Erect herb. Branching from the base. Spikes helicoid. (523)
- Trichodesma amplexicaule** Roxb. Herb. Frequent. Fls. rainy season. (81)
- T. indicum** R. Br. Bulbous based hairy, herb with pale blue flowers. Rare. On rocks. Fls. Sept.-Jan. (726)
- Cordia dichotoma** Forst. f. Small tree. Common on gravelly soil. Fls. March-April. (522)
- ***C. rothii** R. & S. *Goondi*,

Ehretia laevis Roxb. Small deciduous tree on hill slopes. Fls. white ;
Feb.-April. (408)

CONVOLVULACEAE

Convolvulus arvensis Linn. Pubescent twining annual. Fls. pink ;
Dec.-Feb. (69, 499)

C. pluricaulis Chois. Diffuse, densely silky herb. Fls. pale rosy ;
July-Dec. Common in plains. (101, 194)

Cuscuta reflexa Roxb. Parasitic twining herb. Fls. Oct.-Dec. (208)

C. hyalina Roth. A parasitic herb on *Tephrosia*. (652 A)

Evolvulus alsinoides Linn. Diffuse villous perennial herb. Common.
Fls. white or blue ; July-Dec. (303, 380, 542)

Ipomoea coptica (Linn.) Roth apud R. & S. Prostrate annual herb with
white flowers. Frequent. (121)

I. pes-tigridis Linn. Twining pubescent herb of plains. Fls. pale
pink ; rainy season. (206)

I. triquetra R. & S. Pubescent twining herb. Rare ; in fields. Fls.
rainy season. (282)

***I. cairica** (Linn.) Sweet.

I. aquatica Forsk. A floating plant of shallow pools. Common. Fls.
Feb.-May. (479)

I. hispida (Vahl.) R. & S. Slender very hairy twining herb. Common in
fields. Fls. Sept.-Oct. (570)

I. maxima (Linn. f.) Don. Perennial slender twining herb. Frequent.
Fls. Aug.-Sept. (580)

Argyreia speciosa Sweet. Stout handsome climber. Fls. Aug.-Sept.
(506)

Jacquemontia paniculata (Burm. f.) Hall. f. Slender pubescent twiner.
Common on hills. Fls. March-April. (581)

SOLANACEAE

Datura innoxia Mill. Coarse shrub of waste land. Frequent in plains.
Rare on hills. Fls. white ; rainy and winter season. (196, 200)

Lycium europaeum Linn. Spiny shrub. Common on gravel. Fls. June-Nov. (233)

Solanum xanthocarpum Schrad. & Wendl. Spiny diffuse herb. Common in plains and waste lands. Rare. On hills. Fls. Dec.-June. (158, 159)

S. nigrum Linn. *Makoi*. A common weed of plains. Rare on hills. Fls. white ; most of the year. (290, 291)

***S. melongena** Linn.

Withania somnifera Dunal. A perennial much branched herb or under-shrub of waste lands. Fls. Oct.-May. (216)

***Nicotiana tabacum** Linn.

N. plumbaginifolia Viv. An occasional weed near water. Fls. white ; April-May. (513)

***Lycopersicum esculentum** Miller.

***Cestrum nocturnum** Linn.

***Capsicum frutescens** Linn.

Physalis minima Linn. Herbaceous pubescent annual. Frequent in fields and near water. Fls. yellow ; Nov.-Jan. (382)

SCROPHULARIACEAE

Verbascum thapsus Linn. Stellate tomentose herb. Rare. Fls. pale yellow ; April-May. (150, 245)

V. chinense Sant. Annual herb, frequent in moist and shady places. Fls. yellow spurred ; March-May. (265, 370, 496)

Striga gesneroides (Willd.) Vatke. Root parasite on *Euphorbia nivulia*. (728)

S. asiatica (Linn.) O. Kuntze. Slender parasitic herb on roots of *Pennisetum typhoideum*. (729)

Lindenbergia indica (Linn.) O. Kuntze. Glandular hairy annual. Frequent on crevices, old walls and moist banks. Fls. yellow ; August-Nov. (388, 472)

L. machrostachya Benth. Small herb branching from root stock. Leaves reddish. Fls. rainy season. (176)

Bacopa monnieri (Linn.) Pennell. Succulent herb preferring swampy localities. Fls. April-June. (127, 294)

Kickxia ramosissima (Wall.) Janchen. Perennial herb of dry localities. Rare. Fls. April-June. (730)

Veronica anagallis Linn. Erect succulent herb of swamps. Frequent. Fls. pale pink ; March-April. (503, 557)

Limnophila heterophylla Benth. Common herb of swamps. Fls. Feb.-April. (520)

OROBANCHACEAE

Orobanche cernua Loeffl. Parasitic herb. Fls. winter season. (731)

Cistanche tubulosa Wight. Stout unbranched herb. Parasite on *Calotropis*. Fls. winter season. (732)

LENTIBULARIACEAE

Utricularia stellaris Linn f. Floating aquatic. Fls. winter season. (733)

U. flexuosa Vahl. A floating herb of winter season. (659)

BIGNONIACEAE

Tecomella undulata (Smith) Seem. Tree. Occasional on gravel. Fls. March-April. (404)

****Millingtonia hortensis** Linn.

****Kigelia pinnata** DC.

PEDALIACEAE

***Sesamum indicum** DC. Also found as an escape. (734)

Martynia annua Linn. Tall and stout shrub. Common on waste ground. Fls. rose coloured ; rainy season. Fruit characteristic. (131, 132)

Pedaliium murex Linn. Weedy herb of gravel. Fls. Aug.-Oct. (309, 377)

ACANTHACEAE

- Barleria prionitis** Linn. Spiny and bushy undershrub. Frequent on gravel. Fls. yellow; Oct.-March. (41, 80)
- B. acanthoides** Vahl. Spiny herb. Common in plains. Fls. winter season. (734)
- Dipteracanthus prostratus** (Poir.) Nees. Undershrub. Rare; on old walls and moist shady places. Fls. rainy and winter season. (144, 460, 541)
- D. patulus** (Jacq.) Nees. *Katmora*. Small shrub of gravelly soil. Rare. Fls. Aug.-Nov. (246)
- Ruellia tuberosa** Linn. A frequent herb in gardens. Fls. deep blue; June-July. (734)
- Rungia pectinata** (Linn.) Nees. Small ramous weed of open grassy places. Fls. bluish-white; July-Sept. (660)
- Ecbolium linneanum** Kurz. Undershrub of moist and shady places. Rare. Fls. bluish-green; Oct.-Jan. (529)
- Eranthemum nervosum** (Vahl) R. Br. Shrub of shady places. Rare. Fls. blue; Jan.-March. (517)
- Andrographis echioides** Nees. Erect symmetrical herb on old walls and rocks. Rare. Fls. Aug.-Nov. (86, 505)
- Lepidagathis hamiltoniana** Wall. A spiny undershrub with spherical heads. Frequent at hill tops, slopes and waste lands. Fls. Dec.-Feb. (136)
- Rostellularia procumbens** (Linn.) Nees. Annual. Abundant on rocks. Fls. Aug.-Oct. (257)
- Justicia diffusa** Willd. Small herb of plains. Common. Fls. Aug.-Dec. (302)
- Peristrophe bicalyculata** Nees. A shrubby weed. Common. Fls. pink; Sept.-April. (190, 497)
- Adhatoda vasica** Nees. Evergreen gregarious shrub. Abundant at the foot of hills. Rare at hill top. Fls. most of the year. (239)
- Blepharis maderaspatensis** (Linn.) Heyne ex Roth. Prostrate herb of shady places and gravel soils. Rare. Fls. Aug.-Jan. (244A)
- Elytraria acaulis** (Linn. f.) Lindau. A shade loving plant on dried banks and gravelly soil. Fls. Oct.-Dec. (379)

VERBENACEAE

Clerodendrum phlomidis Linn. f. Large shrub at the foot of hills and slopes. Fls. Aug.-Feb. (264)

Stachytarpheta indica Vahl. Glabrous herb with blue flowers. Common at the foot of hills. Fls. Aug.-Nov. (373)

Gmelina arborea Roxb. An unarmed tree of slopes and cool valleys. Rare. Fls. March-April. (58)

Phyla nodiflora (Linn.) Greene. Prostrate herb with oblong heads. Abundant in marshy places. Fls. Oct.-Jan. (8, 258)

Lantana camara Linn. var. **aculeata** Mold. Erect evergreen shrub. Common on road sides. Rare on hills. Flowers throughout the year. (133)

Tectona grandis Linn. f. Tree only seen at Naldeswar. Fls. July-Sept. (17)

Vitex negundo Linn. Large evergreen shrub. Common at the base of hills. Fls. most of the year. (255, 409)

LABIATAE

Leucas lanata Benth. Herb common on hill slopes. Fls. Sept.-Dec. (37)

L. nutans Spreng. Diffuse herb. Fls. Nov.-Jan. (53)

L. cephalotes Spreng. Erect diffusely branched herb. Fls. white in dense globose heads; Aug.-Nov. Frequent in fields and wastelands. (35, 68)

L. aspera Spreng. Annual with white flowers; July-Nov. Common in plains. (735)

L. mollissima Wall. Weak tomentose herb. Rare. Fls. Aug.-Nov. (570)

L. montana Spreng. Soft, woolly herb of rocky jungles and waste grounds. Fls. Nov.-Dec. (604)

***Ocimum sanctum** Linn. *Tulsi*.

***O. basilicum** Linn. *Marva*.

- O. americanum** Linn. *Bapchi*. Erect slender herb. Common on hill slopes. Fls. Aug.-March. (54, 467)
- Anisomeles indica** (Linn.) O. Kuntze. Strong smelling pubescent herb. Fls. purple and bluish ; Sept.-Nov. (42, 49, 55)
- Salvia aegyptiaca** Linn. Herb or small undershrub of winter season. Rare. (88)
- Colebrookea oppositifolia** Sm. Large woolly shrub of valleys. Rare. Fls. Dec.-Feb. (407, 531)
- Plectranthus rugosus** Wall. Shrub of dry places and hill-tops. Fls. March-Oct. (168)

NYCTAGINACEAE

- Boerhavia repens** Linn. var. **diffusa**. Diffuse herb along path and on rocky grounds. Fls. pink ; rainy season. (6)
- B. verticillata** Poir. Decumbent sometimes climbing herb. Common in plains. (736)
- ***Bougainvillea spectabilis** Willd.

AMARANTHACEAE

- Celosia argentea** Linn. Erect glabrous herb. Common on high ground. Fls. pink ; Aug.-Dec. (89)
- Digera muricata** (Linn.) Mart. Slender annual. Common in plains. Fls. Sept.-Oct. (484)
- Amaranthus spinosus** Linn. Erect spiny shrub of wastelands. Fls. most of the year. (327)
- A. gracilis** Desk. Much branched slender herb. Common. Fls. Nov.-Feb. (738)
- A. polygamus** Linn. var. **angustifolius**. Prostrate weed. Common Fls. Nov.-Feb. (738)
- Aerva javanica** (Burm. f.) Spreng. Woolly herb. Rare ; in plains. (64)
- A. sanguinolenta** (Linn.) Blume. Straggling herb of rocky jungles. Frequent. Fls. Jan.-March. (539)
- Pupalia lappacea** (Linn.) Juss. Shade loving straggling undershrub of plains. Common. Fls. July-Dec. (15, 160)

Alternanthera sessilis (Linn.) R. Br. Annual in pure stands near water.
Fls. Aug.-March. (23, 25)

Nothosaerva brachiata Wight. Slender annual with glistening white
flowers. July-Sept. (739)

Achyranthes aspera Linn. Erect herb. Common. Fls. in terminal
spike ; Sept.-Dec. (740)

A. bidentata Blume. Rambling herb of hills. Fls. rainy season. (741)

***Gomphrena globosa** Linn.

CHENOPODIACEAE

Chenopodium album Linn. Erect herb of winter in fields and wastelands.
Common. Fls. in clusters forming paniced spikes ; Jan.-March.
(340)

C. murale Linn. Foetid herb with flowers in dense cymes in axillary
raceme. Aug.-Sept. (146, 533)

***Beta vulgaris** Linn. ***Spinacia oleracea** Linn.

POLYGONACEAE

Polygonum plebejum R. Br. Prostrate herb on dried banks. Abundant.
Fls. pink ; Feb.-May. (189)

P. indicum Heyne. Annual with branches spreading all round. Fre-
quent. Fls. Feb.-May. (742)

P. effusum Meissn. Slender herb of wet places. Common. Fls. pedi-
cellate ; Feb.-May. (743)

P. barbatum Linn. Stout herb of marshes. Common. Fls. Oct.-Nov.
(143)

P. glabrum Willd. Erect annual. Common on edges of tanks and water
courses. Fls. pink ; Aug.-Nov. (142, 466)

Rumex dentatus Linn. Stout erect annual of damp places. Frequent.
Fls. Feb.-March. (279)

***R. hastatus** D. Don. ***Antigonon leptopus** Hook.

ARISTOLOCHIACEAE

- Aristolochia bracteata** Retz. A weak prostrate glabrous herb. Occasional.
Fls. Aug.-Oct. (238)

LAURACEAE

- Cassytha filiformis** Linn. A filiform leafless twining parasite on *Carrisa*.
Fls. most of the year. (744)

PROTEACEAE

- ***Grevillea robusta** A. Cunn.

EUPHORBIACEAE

- Euphorbia microphylla** Heyne ex Roth. Decumbent herb on hill slopes.
Common. Fls. July-Nov. and Jan.-April. (226, 227)
- E. hirta** Linn. Annual clothed with yellow hair. Fls. throughout the
year. (299)
- E. granulata** Forsk. Procumbent herb of plains and gravels. Fls.
Sept.-Nov. (122)
- E. thymifolia** Linn. Small annual often with a pale coppery tinge. Fls.
greater part of the year. (39)
- E. clarkeana** Hook. f. Prostrate herb. Common in fields. (745)
- E. nivulia** Buch.-Ham. Large shrub. Branches fleshy and cylindrical
with pairs of sharp spines. Common on arid hills. Fls. Jan.-
April. (746)
- E. neriifolia** Linn. Large branched shrub, abundant at upper zone of
hills. Fls. Feb.-April. (747)
- E. dracunculoides** Lamk. Much branched, glabrous herb of plains and
low hills. Fls. Sept.-Jan. (748)
- E. hypericifolia** Linn. Decumbent annual. Fls. all the year round.
(749)
- Phyllanthus niruri** auct. Linn. Annual herb of cultivated places. Fls.
yellowish ; Aug.-Sept. (750)
- P. maderaspatensis** Linn. Glabrous herb. Fls. Aug.-Sept. (46)

***Emblica officinalis** Gaertn. Cultivated as well as an escape.

Acalypha ciliata Forsk. Stout herb. Common. Fls. July-Oct. (94)

Ricinus communis Linn. An evergreen shrub. Cultivated as well as wild. Fls. Feb.-March. (751)

Putranjiva roxburghii Wall. Evergreen moderate-sized tree on hills. Frequent. Fls. March-May. (252, 490)

Securinega leucopyrus (Willd.) Muell.-Arg. Woody tortuous bush on base of hills. Fls. July-Aug. (488)

S. virosa (Roxb. ex Willd.) Pax & Hoffm. Deciduous small shrub of rocks. Rare. Fls. May-June. (501)

Mallotus philippinensis Muell.-Arg. Small evergreen tree of upper zone of hills. Rare. Fls. Oct.-Dec. (524)

U L M A C E A E

Holoptelea integrifolia Planch. Large spreading deciduous tree. Abundant on high grounds and valleys. Fls. March-April. (752)

M O R A C E A E

***Morus alba** Linn.

U R T I C A C E A E

***Ficus glomerata** Roxb. ***F. benghalensis** Linn. ***F. religiosa** Linn.
***F. carica** Linn. ***F. cordifolia** Roxb.

***F. tomentosa** Roxb. Small tree, on hill slopes. Frequent. Fls. Jan.-March. (754)

C E R A T O P H Y L L A C E A E

Ceratophyllum demersum Linn. A submerged aquatic herb. Common in still water. (753)

H Y D R O C H A R I T A C E A E

Hydrilla verticillata (Linn. f.) Royle. Slender aquatic herb in running or still water. Fls. July-Sept. (755)

Vallisneria spiralis Linn. Submerged stemless herb, common. Fls. Jan.-May. (756)

SCITAMINEAE

**Canna indica* Linn. **Zingiber officinale* Rosc. **Musa sapientum* Linn.

AMARYLLIDACEAE

**Crinum asiaticum* Linn. **Agave* sp.

DIOSCOREACEAE

**Dioscorea bulbifera* Linn.

LILIACEAE

Asparagus racemosus Willd. *Satawar*. Scandent spinous undershrub. Frequent ; on hills. Fls. Sept.-Dec. (155, 156)

Asphodelus tenuifolius Cav. Annual herb in fields. Common. Fls. Feb.-May. (757)

Gloriosa superba Linn. Herbaceous climber of low jungles. Frequent at Pandopol, Naraini and near Sirska along roadsides. Fls. orange or crimson ; rainy season. (661)

**Aloe barbadensis* Mill.

Scilla indica Baker. Small herb. Bulb ovoid. Rare ; in hilly areas. Fls. greenish purple. July-Aug. (789)

PONTEDERIACEAE

Eichhornia crassipes Solms. Aquatic herb. Common in pools and puddles. Fls. blue ; Feb.-April. (758)

COMMELINACEAE

Commelina benghalensis Linn. Creeping annual of damp and shady places. Fls. rainy season. (135)

C. obliqua Buch.-Ham. Stout 2-3 ft. tall herb of hills. Rare. (211, 468)

Cyanotis axillaris Schult. Glabrous sub-succulent creeping herb. Frequent. Fls. rainy season. (353 & 354)

PALMAE

Phoenix sylvestris Roxb. Tall Palm. Common in nullahs. Fls. May-June. (22)

PANDANACEAE

Pandanus tectorius Soland. ex Parkinson. Bushy shrub in swamps. Fls. rainy season. (759)

TYPHACEAE

Typha angustata Chaub. & Bory. A gigantic, gregarious, marsh plant. Abundant. Fls. July-Aug. (760)

ARACEAE

Pistia stratiotes Linn. Floating herb. Rare. (761)

LEMNACEAE

Lemna minor Linn. Floating aquatic. Very common. Fls. Aug.-Oct. (761A)

L. polyrrhiza Linn. Floating herb. Fronds dark green above, purplish below. Common. Fls. Sept.-Oct. (752A)

Wolffia arrhiza Wimm. Floating aquatic occurring as a green scum. Abundant in puddles. (501B)

NAIADACEAE

Potamogeton nodosus Poir. Floating herb. Common in lakes and puddles. Fls. Aug.-Jan. (519)

P. crispus Linn. Submerged aquatic herb. Fls. Dec.-April. (514)

P. perfoliatus Linn. Aquatic herb of streams. Fls. Jan.-March. Frequent. (556)

P. pectinatus Linn. Submerged aquatic with filiform stem. Abundant at Hansarovar. Fls. Nov.-Jan. (574)

CYPERACEAE

Scirpus corymbosus Heyne ex Roth (592). **S. articulatus** Linn. (83, 85). **S. supinus** Linn. (595). **S. maritimus** Linn. (597). **S. erectus** Poir.

(596). *Fimbristylis schoenoides* Vahl (593). *F. aestivalis* (Retz.) Vahl. var. *squarrosa* (Vahl) Koyama (552). *F. podocarpa* Nees (662). *F. dichotoma* Vahl (594). *Cyperus arenarius* Retz. (760). *C. distans* Linn. f. (591). *C. eleusinoides* Kunth (590). *C. haspan* Boeck. (589). *C. niveus* Retz. (588). *C. conglomeratus* Rottb. (587). *C. tuberosus* Rottb. (586). *C. iria* Linn. (585). *C. kyllinga* Endl. (601, 602). *Eleocharis geniculata* (Linn.) R. & S. (603). *Bulbostylis barbata* Kunth (599 and 600). *B. subspinescens* Clarke (598).

GRAMINEAE

Cenchrus ciliaris Linn. (788). *C. setigerus* Vahl (789). *Setaria glauca* Beauv. (398, 399). *Panicum psilopodium* Trin. (108 and 619). *P. maximum* Jacq. (761). *Paspalidium punctatum* (Burm. f.) A. Camus (614, 615). *Echinochloa crus-galli* (Linn.) Beauv. (95, 616). *E. colonum* (Linn.) Link (575). *Echinochloa* sp. (771). *Brachiaria kurzii* (Hook. f.) A. Camus (663). *B. ramosa* (Linn.) Stapf. (618). *Digitaria sanguinalis* (Linn.) Scop. (96, 106). *Eriochloa procera* (Retz.) C. E. Hubb. (392). *Paspalum distichum* Linn. (614, 615). *Imperata cylindrica* (Linn.) Beauv. (419, 622). *Saccharum arundinaceum* Retz. (769). *S. spontaneum* Linn. (770). *S. bengalense* Retz. (768). *Apluda mutica* Linn. (76, 624). *Arthraxon lancifolius* (Trin.) Hochst. (623). *Chrysopogon fulvus* (Spreng.) Chiov. (74, 396). *Sorghum halepense* (Linn.) Pers. (784). *Bothriochloa pertusa* (Linn.) A. Camus (417). *Dichanthium annulatum* (Forsk.) Stapf. (419). *Heteropogon contortus* (Linn.) Beauv. ex R. & S. (391). *Vetiveria* sp. (783). *Cymbopogon jwarancusa* (Jones) Schult. (781). *Aristida depressa* Retz. (776). *A. funiculata* Trin. ex Rupr. (628). *Perotis indica* (Linn.) O. Ktze. (394). *Sporobolus maderaspatanus* Bor (762). *S. diander* Beauv. (84, 620). *S. tremulus* (Willd.) Kunth. (621). *Polypogon* sp. (782). *Eragrostis ciliaris* (Linn.) R. Br. (766). *E. pilosa* Beauv. (610). *E. coarctata* Stapf (611). *E. tenella* (Linn.) Beauv. ex R. & S. (51, 14, 613). *Desmostachya bipinnata* (Linn.) Stapf. (416). *Melanocenchris jacquemontii* Jaub. & Spach. (777). *Cynodon dactylon* Pers. (767). *Tetrapogon villosus* Desf. (107). *T. tenellus* (Roxb.) Chiov. (763). *Chloris virgata* Sw. (400). *C. dolichostachya* Lag. (401, 402). *C. barbata* Sw. (765). *Schoenefeldia gracilis* Kunth. (764). *Eleusine indica* Gaertn. (775). *Dactyloctenium aegyptium* (Desf.) Beauv. (125, 395). *Acrachne racemosa* (Heyne) Ohwi. (393). *Hygrorrhiza aristata* Nees ex Wt. & Arn. (773). *Dendrocalamus strictus* Nees (192).

STATISTICAL SYNOPSIS

The number and percentage of families, genera, and species in Dicotyledons and Monocotyledons are as follows :

	Dicotyledons		Monocotyledons		Total
	% of total	No.	% of total	No.	
Families	85	69	15	12	81
Genera	80.54	236	19.46	57	293
Species	78.36	344	21.04	95	439

The largest families having ten or more species are Scrophulariaceae (10), Capparidaceae (11), Malvaceae (11), Labiatae (11), Convolvulaceae (13), Amaranthaceae (14), Acanthaceae (16), Euphorbiaceae (17), Cyperaceae (21), Compositae (24), Leguminosae (51), and Gramineae (53).

The various genera are poorly represented. The largest genera having 5 or more species are *Polygonum* (5), *Scirpus* (5), *Indigofera* (6), *Ipomoea* (6), *Leucas* (6), *Acacia* (6), *Euphorbia* (9) and *Cyperus* (9).

Out of 439 species 68 are trees, 89 shrubs and undershrubs, and 282 herbs. Climbing plants are represented by 33 species; *Cuscuta reflexa*, *Cuscuta hyalina*, *Striga asiatica*, *Striga gesneroides*, *Cassytha filiformis*, *Cistanche tubulosa*, and *Orobancha cernua* are parasites. *Utricularia stellaris* and *Utricularia flexuosa* represent carnivorous plants.

DISCUSSION

In recent years, the problem why plants grow in particular localities has attracted the attention of several plant ecologists. There are several contributions on the structure and dynamics of vegetation, in a process of change and being modified by modern civilization. It has been suggested by Billings (1952) that the vegetation of a given area can be used as an indicator of the total environment if the tolerance of characteristic species is known and if the vegetation is adequately analysed by statistical and floristic methods.

The arid and semi-arid tracts of Rajasthan support various integrated plant communities as shown by different workers. It is however felt that the information on the ecological status of the vegetation of different parts of Rajasthan is fragmentary. The phytogeographical

and geological status of Rajasthan has been debated in recent years. The floristic composition of the area and its ecological status may be useful indices of its past, consequently the present study was designed to relate the vegetation with the environment and to understand the phytogeographical status of the area.

The environmental complex of the area from the view point of climate, soils, and biotic factors has been found to be adverse. The moisture content of the area is characterized by a considerably long period of water deficit due to low and irregular rainfall, high evapo-transpiration rates, and potential evapo-transpiration generally exceeding precipitation. This is further aggravated by adverse temperatures during the months of water deficit resulting in semi-arid to arid climate.

The corollary that the vegetation is an index of the environment may well be justified. The presence of sparse ground cover during the summer and winter months and of abundant ground cover during the rains the plant communities consisting of a few trees and shrubs and a large number of ephemerals, the deciduous nature of the forest tree species and the xerophytic adaptations like development of thorns, thickening of leaves, development of tomentum, white bark, etc. all suggest the semi-arid climate of the area.

It is possible to distinguish plant communities as affected by topography, soil nature, and available soil moisture, in addition to the adverse factors of the climate. The vegetation on the top of the hills consists of a few plant communities which seem to be controlled by the available soil moisture and exposure. The gentle slopes and the basal zone of hills support a richer vegetation due to better soil formation and increased water-holding capacity.

The soils on the hills and in the valleys are comparatively richer in humus and nitrate content which promotes the aggregation of soil particles and increases water-holding capacity. These soils are either neutral or slightly acidic and support a better vegetation, consisting of tree species. On the other hand, the soil of the plains is sandy with a low percentage of nitrates, and humus, and consequently of low water-holding capacity and alkaline in nature. It is, therefore, less favourable for the growth of trees and favours the growth of grasses and other herbs.

The flora is characterized by the complete absence of Guttiferales and Ericales, poor representation of Ranales, Caryophyllinae, Geraniales, Celastrales, Sapindales, Passiflorales, and Rubiales. The orders like Malvales, Parietales, Rosales, Myrtales, Gentianales, Polemoniales, Personales, Lamiales are well represented. Among Monochlamydeae, Amaranthaceae and Euphorbiaceae are very well represented.

The flora of this area has considerable similarity with that of the other investigated areas of north-eastern Rajasthan. The Table below gives

the strength of dominant families and genera in the different investigated areas of this zone of Rajasthan.

TABLE SHOWING THE NUMBER OF SPECIES BELONGING TO DOMINANT FAMILIES AND GENERA IN VARIOUS INVESTIGATED AREAS OF NORTH-EAST RAJASTHAN

S. No.	Family or Genus	Alwar	Ajit Sagar	Chirawa	Harsh- nath	Lohargal	Pilani
FAMILY							
1.	Gramineae	53	22	19	18	?	49
2.	Leguminosae	50	29	24	27	22	34
3.	Compositae	24	13	12	20	10	18
4.	Cyperaceae	21	8	3	4	?	5
5.	Euphorbiaceae	17	10	6	10	8	12
6.	Acanthaceae	16	10	2	8	10	8
7.	Amaranthaceae	14	10	8	11	6	8
8.	Convolvulaceae	13	8	4	7	3	8
9.	Malvaceae	11	10	3	6	6	11
10.	Capparidaceae	11	4	5	4	2	4
11.	Labiatae	11	6	3	5	8	6
12.	Tiliaceae	8	9	5	5	4	8
13.	Boraginaceae	9	9	3	8	4	9
14.	Scrophulariaceae	10	7	1	6	2	4
15.	Solanaceae	7	6	6	8	7	6
16.	Ficoidaceae	6	8	8	7	3	9
GENUS							
1.	<i>Euphorbia</i>	9	6	2	5	3	5
2.	<i>Cyperus</i>	9	5	2	2	?	2
3.	<i>Indigofera</i>	6	5	3	8	2	5
4.	<i>Leucas</i>	6	4	2	3	1	3
5.	<i>Acacia</i>	6	3	5	4	2	5
6.	<i>Ipomoea</i>	6	4	1	3	1	3
7.	<i>Scirpus</i>	5	nil	1	1	?	1
8.	<i>Tephrosia</i>	4	7	1	2	3	5
9.	<i>Heliotropium</i>	4	5	3	4	1	6
10.	<i>Cassia</i>	4	3	5	2	3	4

It may be concluded that the flora of the investigated area approaches that of Mount Abu, the highest peak of the Aravallis. Species like *Flacourtia indica*, *Helicteres isora*, *Lannea coromandelica*, *Woodfordia fruticosa*, *Mitragyna parvifolia*, *Vogelia indica*, *Ehretia laevis*, and *Mallotus philippensis* growing in the present area have not been reported from any part of Rajasthan except Mount Abu.

In the flora of the investigated area three distinct elements, namely Perso-Arabic, Indo-Malayan, and General, can be distinguished. Of the three elements, the Perso-Arabic is represented by 164 species and the Indo-Malayan by 83 species. The Indo-Malayan element is thus half of the Perso-Arabic element.

In western Rajasthan, according to Blatter and Hallberg (1918-21) and Biswas and Rao (1953), the Indo-Malayan element is only one-seventh of the Perso-Arabic. In the flora of Ajit Sagar Bundh, eastern

Rajasthan, this proportion is a little more than one-third (Nair & Kanodia 1959), and in the flora of Harshnath, eastern Rajasthan (Nair & Nathawat 1957) this proportion is a little less than one half.

From the above data it is, therefore, clear that in the flora of Rajasthan, the Perso-Arabic element predominates over the Indo-Malayan element. The percentage of Indo-Malayan element increases as one proceeds from west to east. According to the suggestions of Drude (1890, 1913) supported by Blatter & Hallberg (1918-1921) and Biswas & Rao (1953), the line of demarcation between the Indo-Malayan flora and the Perso-Arabic flora ranges from the gulf of Cambay northwards along the Aravallis. If Drude's conclusions were correct, a place situated on the east of Aravallis should have a predominance of the Indo-Malayan element. On the contrary, the vegetation of the investigated area has a larger proportion of the Perso-Arabic element. It may, therefore, be suggested that a demarcation line should be sought more towards the east, even beyond the limits of Rajasthan.

SUMMARY

1. The present work is a contribution to the flora of north-east Rajasthan. The area of study is Alwar District.
2. The location and physiography of the area have been given.
3. The environmental factors affecting the vegetation have been discussed.
4. Statistical analysis of the flora indicates that there are 439 indigenous species belonging to 293 genera and 81 natural orders.
5. A comparative account reveals that the present area is the most complex in north-east Rajasthan and approaches that of Mount Abu the highest peak of the Aravalli range.
6. It is concluded that the vegetation of the investigated area is of semi-arid type and may be a deterioration product of a climatic climax vegetation.
7. Phytogeographical affinities lie mainly with the Perso-Arabic rather than with the Indo-Malayan regions.

ACKNOWLEDGEMENTS

I am deeply indebted to Dr. B. N. Mulay, Professor and Head of the Department of Botany, Birla College, Pilani, under whose constant guidance the present investigation was carried out. My sincere thanks are due to Dr. B. V. Ratnam, Principal, Lohia College, Churu, and Shri Shanti Sarup, Principal, Rampuria College, Bikaner, for helpful suggestions. I am greatly obliged to Dr. M. B. Raizada, Head of the

Division of Forest Botany, Forest Research Institute, Dehra Dun, and Dr. N. C. Nair, Botanical Survey of India, Dehra Dun, for the help in checking and confirming the identification of the species described in this paper.

REFERENCES

- BAKSHI, T. S. (1954) : The vegetation of Pilani and its neighbourhood. *J. Bombay nat. Hist. Soc.* **52** : 484-514.
- BILLINGS, W. D. (1952) : The environmental complex in relation to plant growth and distribution. *Quart. Rev. of Bio.* **27** (3) : 251-265.
- BISWAS, K. & RAO, R. S. (1953) : Rajputana Desert vegetation. *Proc. nat. Inst. Sci. India* **19** : 411-21.
- BLATTER, E. & HALLBERG, F. 1918-21: The flora of the Indian desert. *J. Bombay nat. Hist. Soc.* **26-27** different pages.
- DRUDE, O. (1890) : Handbuch der Pflanzengeographie. Stuttgart.
- (1913) : Die Oekologie der Pflanzen. Brunswick.
- JOSHI, M. C. (1958) : A comparative study of the vegetation of some areas in Jaipur division. *J. Indian Bot. Soc.* **36** : 279-91.
- MULAY, B. N. & MATHUR, S. C. (1961) : A preliminary ecological survey of plant communities in and around Tonk District (Rajasthan). *Proc. Rajasthan Acad. Sci.* **8** : 31-42.
- , & RATNAM, B. V. (1950) : Vegetation found nearabout Pilani. *Proc. Indian Sci. Congress, Poona* : 64-65.
- NAIR, N. C. (1956) : Flora of Chirawa. *Proc. Rajasthan Acad. Sci.* **6** : 49-64.
- NAIR, N. C. (1961) : Vegetation of Jhunjhunu, Mandrela and neighbouring places. *J. Bombay nat. Hist. Soc.* **58** : 433-440.
- , & NATHAWAT, G. S. (1956) : Vegetation of Pilani and its neighbourhood. op. cit. **54** : 91-106.
- (1957) : Vegetation of Harshnath hills. *ibid.* **54** : 281-301.
- , & KANODIA, K. C. (1959) : A study of the vegetation of Ajit Sagar Bundh, Rajasthan. op. cit. **56** : 524-557.
- , & THOMAS, T. A. (1961) : The vegetation of Khetri Town and its neighbourhood. *Proc. Rajasthan Acad. Sci.* **8** : 99-110.
- RAMCHANDRAN, K. R. (1950) : Common grasses found round about Pilani. *Proc. Indian Sci. Congr. Poona* : 65-66.
- RATNAM, B. V. (1951) : The vegetation of Lohargal. *Proc. Rajasthan Acad. Sci.* **2** : 26-36.
- SARUP, S. (1961) : Hydrophytes of Bharatpur. A preliminary Study. *Uni. Rajasthan Studies* **5** : 1-11.
- SHARMA, V. S. (1958) : The Flora of Ajmer. *J. Bombay nat. Hist. Soc.* **55** : 129-141.
- VYAS, L. N. (1962) : Vegetation of Jai Samand lake, Alwar. *Proc. Rajasthan Acad. Sci.* **9** : 45-63.